



ON THE FOSSIL LOCALITY “LADEIRA DO BERLENGA”  
(SANTANA FORMATION, ARARIPE BASIN), PIAUÍ, NORTHEASTERN BRAZIL<sup>(1)</sup>

(With 4 figures)

ALEXANDER W. A. KELLNER <sup>(2)(3)</sup>  
VALÉRIA GALLO <sup>(4)</sup>  
ALAMO S. F. SARAIVA <sup>(5)</sup>  
JULIANA M. SAYÃO <sup>(2)(6)</sup>  
HELDER DE P. SILVA <sup>(2)(7)</sup>

**ABSTRACT:** Despite known for several decades, the paleontological content of the Santana Formation (Romualdo Member, Araripe Basin) in Piauí State was restricted to the crocodylomorph *Araripesuchus*, the paratype of *Paraelops cearensis*, and the holotype of *Santanaclupea silvasantosi*. Fieldwork carried out in the locality “Ladeira do Berlenga” resulted in the discovery of several fish taxa which were found in two levels. The lower level is formed by large and massive calcareous concretion of yellowish color, which showed the presence of two small (1-3 cm) taxa referable to Clupeomorpha (*Santanaclupea* and a new taxon). In the upper portion of the sequence, the calcareous concretion are rounded and show a beige color, furnishing the following taxa: *Araripelepidotes* (Semionotidae), *Placidichthys* (Ophiopsidae), *Calamopleurus* (Amiidae), *Vinctifer* (Aspidorhynchidae), *Rhacolepis* (Pachyrhizodontidae), and *Tharrhias* (Chanidae). Besides those, *Brannerion* and *Cladocylus* were also reported previously in this locality. Most of those taxa have already been recorded in different parts of the Araripe Basin, particularly in the state of Ceará, indicating that the paleoichthyofauna was widespread within the different geographic areas of the Araripe Basin.

**Key words:** Araripe Basin, Santana Formation, Piauí State, Fossil fishes.

**RESUMO:** A localidade fossilífera “Ladeira do Berlenga” (Formação Santana, Bacia do Araripe), Piauí, Nordeste do Brasil.

Apesar de conhecido por muitas décadas, o conteúdo paleontológico dos afloramentos da Formação Santana (Membro Romualdo, Bacia do Araripe), no Estado do Piauí, era restrito ao crocodilomorfo *Araripesuchus*, ao parátipo de *Paraelops cearensis* e ao holótipo de *Santanaclupea silvasantosi*, além da breve menção da presença de outros táxons. Trabalho de campo nesta região resultou no encontro de uma diversidade de peixes fósseis em dois níveis distintos. O mais basal, formado por nódulos calcários maciços de coloração amarelada, forneceu apenas peixes de pequeno porte (1-3cm), que representam duas espécies de Clupeomorpha (*Santanaclupea* e um novo táxon). Na porção superior, com nódulos arredondados de coloração bege, foram encontradas as seguintes formas: *Araripelepidotes* (Semionotidae), *Placidichthys* (Ophiopsidae), *Calamopleurus* (Amiidae), *Vinctifer* (Aspidorhynchidae), *Rhacolepis* (Pachyrhizodontidae) e *Tharrhias* (Chanidae). Além dessas, foram registrados anteriormente *Brannerion* e *Cladocylus*. A maior parte dessas formas já foi encontrada em diversos pontos da bacia, principalmente no Estado do Ceará, indicando uma distribuição geográfica desta paleoictiofauna por toda a Bacia do Araripe.

**Palavras-chave:** Bacia do Araripe, Formação Santana, Estado do Piauí, Peixes fósseis.

<sup>1</sup> Received on July 31, 2001. Accepted on March 28, 2002.

<sup>2</sup> Museu Nacional/UFRJ, Departamento de Geologia e Paleontologia. Quinta da Boa Vista, São Cristóvão, 20940-040, Rio de Janeiro, RJ, Brasil.

<sup>3</sup> Fellow of Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq).

Associate Researcher - American Museum of Natural History, New York.

E-mail: kellner@mn.ufrj.br.

<sup>4</sup> Universidade do Estado do Rio de Janeiro (UERJ), Departamento de Biologia Animal e Vegetal, Instituto de Biologia Roberto Alcântara Gomes. Rua São Francisco Xavier, 524, Maracanã, 20550-013, Rio de Janeiro, RJ, Brasil.

Fellow of PROCiência-UERJ.

E-mail: gallo@uerj.br.

<sup>5</sup> Universidade Regional do Cariri. Cel. Antonio Luís, 1161, 63100-000, Crato, CE, Brasil.

E-mail: alamo@urca.br.

<sup>6</sup> Graduate student, Programa de Pós-Graduação em Ciências Biológicas/Zoologia, Museu Nacional/UFRJ.

Fellow of Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ).

E-mail: jsayao@mn.ufrj.br.

<sup>7</sup> E-mail: helder@acd.ufrj.br.

## INTRODUCTION

The Araripe Basin has some of the richest fossil deposits from Brazil. Known since the 19<sup>th</sup> century, this basin is situated between the states of Ceará, Pernambuco, and Piauí. The most fossiliferous strata belong to the Santana Formation, which is divided into the members Crato, Ipubi, and Romualdo (BEURLEN, 1971; MABESOONE & TINOCO, 1973). Palynological data indicate that those rocks have been formed during the Early Cretaceous (Aptian-Albian, see PONS, BERTHOU & CAMPOS, 1990).

The fossils from the Santana Formation belong to very distinct *Lagerstätten* formed by the sedimentary rocks of the Crato and the Romualdo members (*e.g.*, KELLNER & CAMPOS, 1999). The fossils from the latter are particularly well preserved, including the preservation of phosphatized soft tissues in several fishes (MARTILL, 1988) and tetrapods (KELLNER & CAMPOS, 1998). This exquisite preservation and the large quantities of specimens have made this deposit known worldwide (for a review see MAISEY, 1991 and SANTOS, 1991).

Most producing localities of the Romualdo Member (as well as for all Santana Formation) are situated in the state of Ceará and the majority of the fossils known to date came from there. Despite being less studied, there are several sites in Pernambuco and Piauí states that have a great potential for new findings. Among those is the locality "Ladeira do Berlenga" (Piauí State), where the layers from the Romualdo Member crop out. In 1946, an expedition organized by the Conselho Nacional do Petróleo (CNP) and led by Frederick B. Plummer, went to this region and collected several fossils (CONSELHO NACIONAL DO PETRÓLEO, 1948), most still unstudied so far. Among the few exceptions is the crocodyliform *Araripesuchus gomesii* described by PRICE (1959) and the paratype of the albuloid *Paraelops cearensis* described by SANTOS (1971). During regional mapping activities developed in the northeastern part of Brazil, GOMES *et al.* (1981:138) briefly mentioned the specimens collected by CNP, which were attributed tentatively to several taxa. One of those (DGM 515-P) was later studied by MAISEY (1993) and named *Santanaclupea silvasantosi*, consisting the first clupeomorph from the Santana Formation.

At the beginning of 2000, some of us visited the "Ladeira do Berlenga" locality and collected

several specimens (KELLNER *et al.*, 2000), including previously unknown taxa for this region. Here we briefly report on those fossils and update the faunal list of this locality.

## GEOLOGICAL SETTING

The rocks of the Araripe Basin in Piauí represent the most western parts of the basin. The predominant stratigraphic unit is the Exu Formation, composed by yellowish and reddish sandstones, that form the upper portion of the Araripe Plateau. Outcrops of the Santana Formation are found underneath the sandstones, but tend to be covered by vegetation and are not easily accessible. Only the rocks of the Romualdo Member were identified in the field, and we found no evidence of the evaporites of the Ipubi Member nor of the laminated limestones that characterize the Crato Member.

The best outcrops of the Romualdo Member were found at the locality "Ladeira do Berlenga", situated on the Marcolândia-Fronteira road. The main outcrop is situated directly along the sides of the road (GPS: S 07°17'10.9"; W 040°35'42.6") and is locally called "cascalheira". Other outcrops have been found in farms nearby and close to the road. However, their extent is limited and contrasts with the far larger exposures of the Santana Formation in Ceará and Pernambuco, especially where there have been mining activities.

All fossils were found in calcareous nodules embedded in dark shales. Nodules occur in two distinct levels. The basal one is formed by large nodules, that are more massive, tend to be tabular, and have a yellowish color. So far only small fishes have been found (two distinct taxa referable to Clupeomorpha, one possibly *Santanaclupea*).

The nodules from the upper portion tend to be rounded, are of beige color and overall very similar to the concretions found in other parts of the Araripe Basin. Here several taxa of fish have been found indicating a higher diversity. Like in other parts of the Araripe Basin, the nodules of the upper section tend to follow the shape of the outlines of the fishes (MAISEY, 1991).

## PALEONTOLOGICAL CONTENT

All fossils recovered so far are actinopterygians. The most abundant fossils in the lower level are the two distinct taxa referable to Clupeomorpha (MN6100-V; Fig.1). They are small, ranging from 1 to 3cm in length. Several specimens have

been collected which are confined in a calcareous layer of about 30cm. One of those is possibly *Santanaclupea* (Fig.1A), but the other is likely a different taxon (Fig.1B), since it lacks ornamentation in the vertebrae (specimen MN 6704-V, not figured) and has less elongated jaw than the former (see MAISEY, 1993). This second taxon is presently being studied from other parts of the basin (FIGUEIREDO & GALLO, 2001).

On the upper level the following genera were found: *Araripelepidotes* (Semionotidae, MN6705-V), *Placidichthys* (Ophiopsidae, MN6090-V - Fig.2), *Calamopleurus* (Amiidae; MN 6711-V), *Vinctifer* (Aspidorhynchidae, MN6710-V - Fig.3), *Rhacolepis* (Pachyrhizodontidae, MN6708-V - Fig.4), and *Tharrhias* (Chanidae, MN6706-V). More specimens have been collected, but until preparation is completed no taxonomic identification can be made. GOMES *et al.* (1981) also mentioned the occurrence of *Brannerion*, *Cladocyclus*, and, with doubts, *Dastilbe* (the latter might be a misidentification). The most abundant taxon is the aspidorhynchid *Vinctifer*, with

individuals varying in size from 15cm to over 50cm, with the larger ones being generally incomplete. The taxon *Rhacolepis* is also well represented by several almost complete individuals. Only very few specimens of the amiid *Calamopleurus* were found. Those tend to be incomplete and show only part of the skeletons (no complete specimen has been collected).

The most interesting specimen collected is referred to the ophiopsid *Placidichthys bidorsalis* described by BRITO (2000). This taxon was previously known from outcrops in Ceará State and, so far, constitute a rare element in the fish fauna of the Romualdo Member. As typical for this taxon, the specimen collected at the "Ladeira do Berlenga" site (Fig.2) has an elongated and slender body, rather heavily covered by slender ganoid scales, and the diagnostic two dorsal fins (BRITO, 2000). So far, this is the only unequivocally ophiopsid fish known from the Santana Formation. SANTOS & VALENÇA (1968) have reported the occurrence of an Ophiopsidae in the Santana Formation, but up to now the material was never described (MAISEY, 1991).

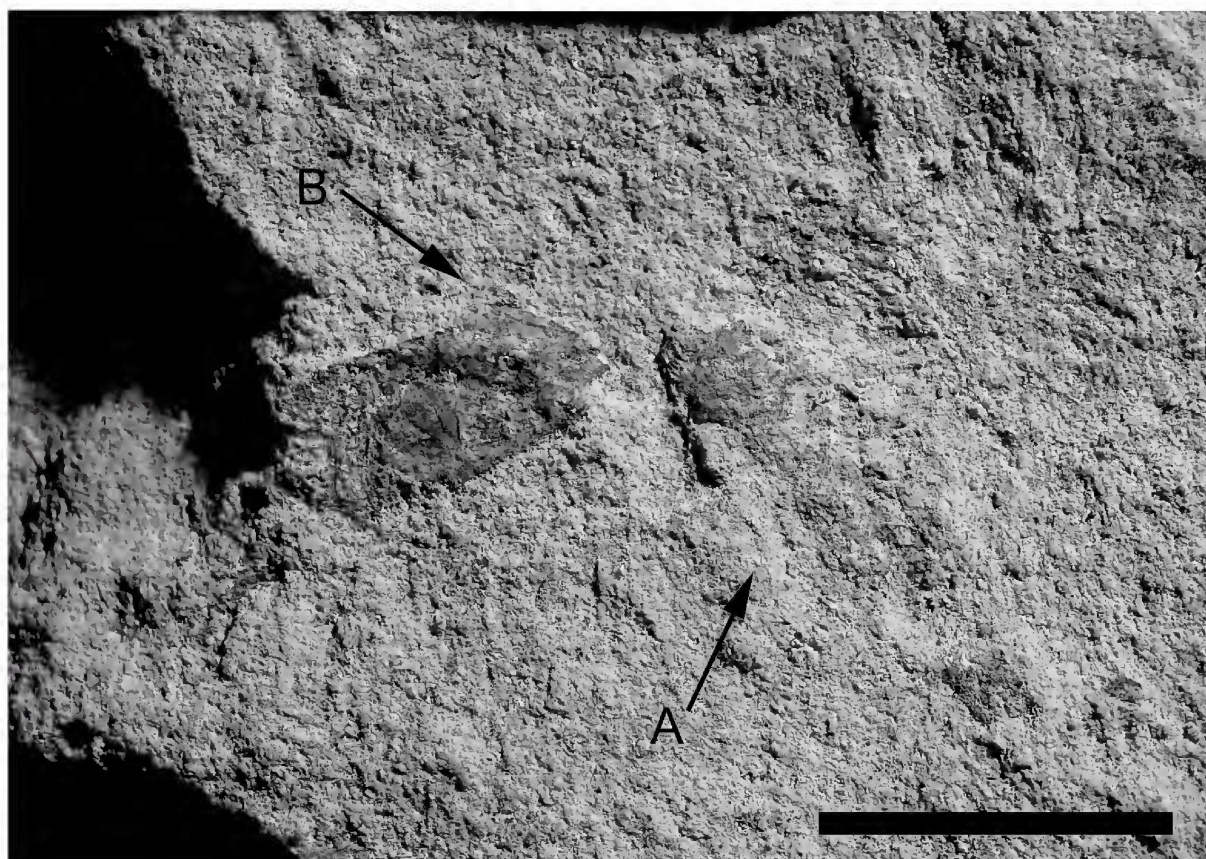


Fig.1- Small (1-3cm) fish referable to Clupeomorpha (MN 6100-V): (A) possible specimen of *Santanaclupea*; (B) undescribed taxon. Scale bar = 20mm.

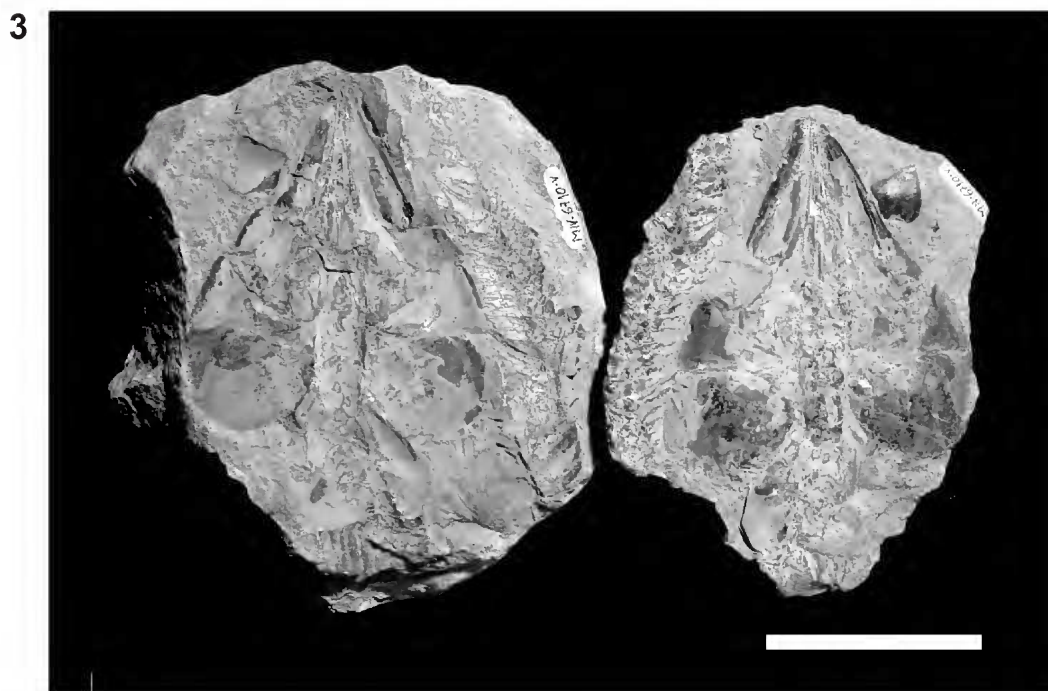
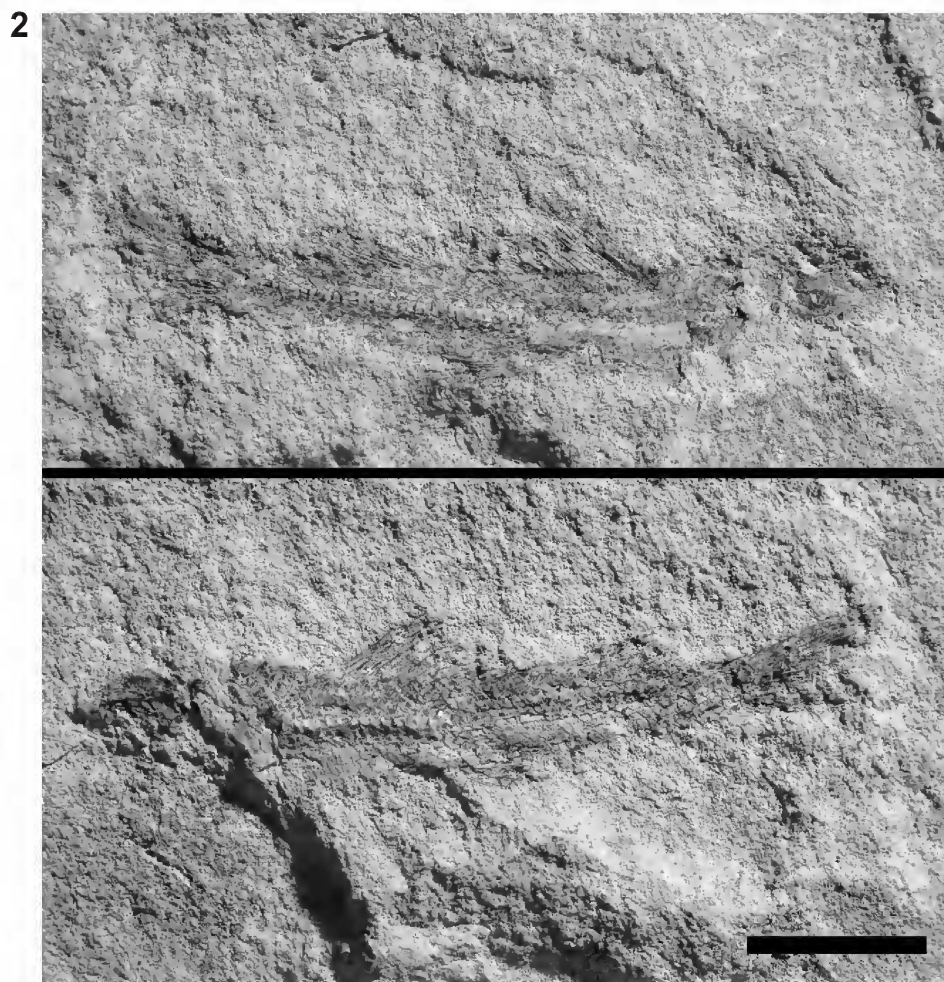


Fig.2- Specimen of *Placidichthys* (Ophiopsidae; MN 6090-V) (scale bar = 20cm); fig.3- *Vinctifer* (Aspidorhynchidae; MN-6710) (scale bar = 50mm).

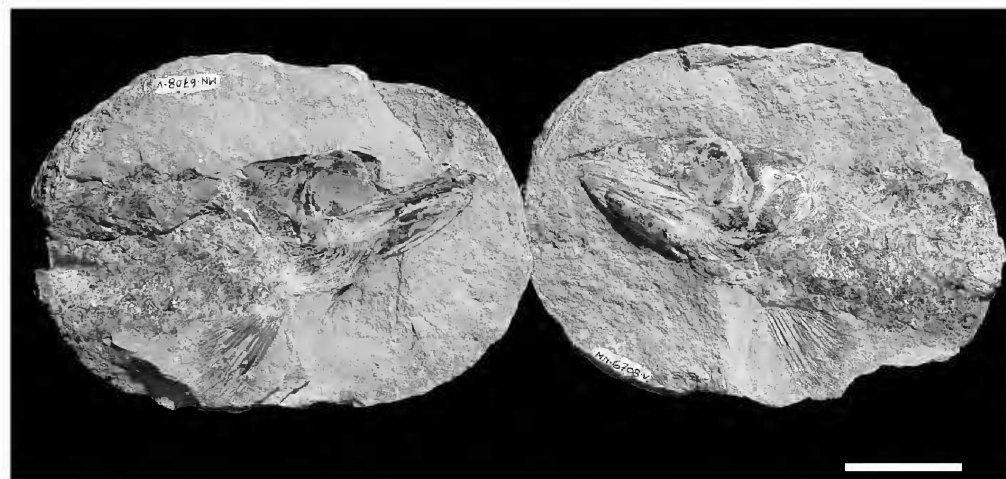


Fig.4- Specimen of *Rhacolepis* (Pachyrhizodontidae, MN 6708-V). Scale bar = 50mm.

#### DISCUSSION

Although the Santana Formation in Piauí provided the first tetrapod from the Araripe Basin (PRICE, 1959), the fossil localities of that region were not further explored. The site “Ladeira do Berlenga” and its surroundings are now shown to be quite fossiliferous. Here we record several common taxa of actinopterygian fishes that are well known from other parts of the basin, particularly in Ceará, expanding the faunal list briefly presented by GOMES *et al.* (1981). This indicates a faunal continuity in the Araripe Basin during the Aptian-Albian. However, some rare elements have been found too, such as the two clupeomorphs (*Santanaclupea* and an undescribed taxon) and one halecomorph (*Placidichthys*).

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